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10/024,359	12/21/2001	Mohammed Asif Khan	8350.0243-00	6525

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EXAMINER	
SHARON, AYAL I	
ART UNIT	**PAPER NUMBER**
2123	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/02/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/024,359	KHAN, MOHAMMED ASIF	
	Examiner	Art Unit	
	Ayal I. Sharon	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 November 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-60* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-60* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12/21/2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Introduction

1. Claims 1-60 of U.S. Application 10/024,359 are currently pending. The application was originally filed on 12/21/2001.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/16/2006 has been entered.
3. The claims submitted on 10/10/2006 have been entered for examination.

Claim Objections

4. Claims 1 and 23 are objected to because of the following informalities: "Pa***net***lides" (emphasis added) is spelled "Pa***nte***lides" (emphasis added) in page 1 of the specification, and in the other claims. Appropriate correction is required.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. **Claims 1-60 are rejected under 35 U.S.C. 101 because the claimed invention preempts a 35 U.S.C. 101 judicial exception. The claims preempt every "substantial practical application" of an idea – a mathematical algorithm.**

7. One may not patent every "substantial practical application" of an idea, law of nature or natural phenomena because such a patent "in practical effect be a patent on the [abstract idea] itself." Gottschalk v. Benson, 409 U.S. 63, 71-72, 175 USPQ 673, 676 (1972).

8. According to MPEP § 2106 (IV)(C)(3), a claim that recites a computer that solely calculates a mathematical formula (see Benson) or a computer disk that solely stores a mathematical formula is not directed to the type of subject matter eligible for patent protection.

9. All of the claims in the instant application share this defect.

10. The Examiner asserts that the "symbolic processing" of mathematical equations constitutes an abstract idea. Moreover, neither the specification, nor any of the claims are restricted to any field of application, or substantial practical use, that is more specific than "simulating a system".

11. Moreover, neither the specification or the claims provide a substantial practical use for the claimed invention that is more specific than "simulating a system".

12. The prior art cited in the 35 U.S.C. § 102 rejections below (see pp.36-37 of the Cellier reference) teaches the use of the claimed subject matter in mechanical, thermodynamic, chemical reaction dynamics, and electrical applications. These different applications share nothing in common other than the underlying math.

13. **Claims 1-60 are also rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claims lack a "concrete, useful, tangible" result.**

14. The claims are directed to methods and apparatuses for "simulating a system". This claimed subject matter lacks a practical application of a judicial exception (law of nature, abstract idea, naturally occurring article/phenomenon) since it fails to produce a useful, concrete and tangible result as required in State Street Bank & Trust Co. v. Signature Financial Group Inc., 149 F. 3d 1368, 1373-74 (Fed. Cir. 1998) and AT&T Corp. v. Excel Communications, Inc., 172 F.3d 1352, 50 USPQ2d 1447 (Fed. Cir. 1999).

15. The claimed invention as a whole must be useful and accomplish a practical application. That is, it must produce a "useful, concrete and tangible result." State Street, 149 F.3d at 1373-74. The purpose of this requirement is to limit patent protection to inventions that possess a certain level of "real world" value, as opposed to subject matter that represents nothing more than an idea or concept, or is simply a starting point for future investigation or research (Brenner v. Manson, 383 U.S. 519, 528-36 (1966)); In re Fisher, 421 F.3d 1365 (Fed. Cir. 2005); In re Ziegler, 992 F.2d 1197, 1200-03 (Fed. Cir. 1993)).

16. The test for practical application as applied by the examiner involves the determination of the following factors:

- "**Useful**" – According to MPEP § 2106 (IV)(C)(2)(2)(a), the USPTO's official interpretation of the utility requirement provides that the utility of an invention has to be (i) specific, (ii) substantial and (iii) credible. MPEP § 2107 and In re Fisher, 421 F.3d at 1372 (citing the Utility Guidelines with approval for interpretation of "specific" and "substantial"). In addition, when the examiner has reason to believe that the claim is not for a practical application that produces a useful result, the claim should be rejected, thus requiring the applicant to distinguish the claim from the three 35 U.S.C. 101 judicial exceptions to patentable subject matter by specifically reciting in the claim the practical application.
- "**Tangible**" - Applying In re Warmerdam, 33 F.3d 1354 (Fed. Cir. 1994), the examiner will determine whether there is simply a mathematical construct claimed, such as a disembodied data structure and method of making it. If so, the claim involves no more than a manipulation of an abstract idea and therefore, is nonstatutory under 35 U.S.C. § 101. In addition, According to MPEP § 2106 (IV)(C)(3), a claim that recites a computer that solely calculates a mathematical formula, or a computer disk that solely stores a mathematical formula, is not directed to the type of subject matter eligible for patent protection. Gottschalk v. Benson, 409 U.S. 63 (1972).

- "**Concrete**" - According to MPEP § 2106 (IV)(C)(2)(2)(a), a claimed process must have a result that can be substantially repeatable, or the process must substantially produce the same result again. In re Swartz, 232 F.3d 862, 864 (Fed. Cir. 2000) (finding that an asserted result produced by the claimed invention is "irreproducible" claim should be rejected under section 101). The opposite of "concrete" is unrepeatable or unpredictable. An appropriate rejection under 35 U.S.C. § 101 should be accompanied by a lack of enablement rejection, because the invention cannot operate as intended without undue experimentation.

17. An example of a concrete, useful, tangible result is provided in State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. ("[T]he transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces 'a useful, concrete and tangible result' – a final share price momentarily fixed for recording and reporting purposes and even accepted and relied upon by regulatory authorities and in subsequent trades").

18. Another example of a concrete, useful, tangible result is provided in AT&T, 172 F.3d at 1358, 50 USPQ2d at 1452 (Claims drawn to a long-distance telephone billing process containing mathematical algorithms were held patentable subject matter because the process used the algorithm to produce a useful, concrete,

tangible result - a primary inter-exchange carrier ("PIC") indicator - without preempting other uses of the mathematical principle).

19. The claimed subject matter does not produce a useful or tangible result:

- A **"Useful"** result is missing because the claimed subject matter fails to sufficiently reflect at least one practical utility set forth in the descriptive portion of the specification. More specifically, both the described practical utility in the specification, and the claimed subject matter relate ONLY "simulating a system", which is not a specific or substantial practical utility.
- A **"Tangible"** result is missing because the claimed subject matter fails to produce a result that is limited to having real world value rather than a result that may be interpreted to be abstract, such as a thought, a computation, or manipulated data. More specifically, the claimed subject matter provides for "generating an output that simulates a system". The output of a mathematical formula reads on this limitation. This produced result remains in the abstract and, thus, fails to achieve the required status of having real world value. Moreover, the claims that recite a computer that solely calculates the mathematical formula, or a computer disk that solely stores a mathematical formula, are not directed to the type of subject matter eligible for patent protection.

20. Figures 1-2 and 4-6 are flowcharts of the claimed embodiments for "simulating a system". These figures, and their associated text are directed to purely

mathematical algorithms. See, for example, Figures 4 and 6. No specific substantial practical application is recited in specification, or in the claims.

Claim Rejections - 35 USC § 103

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

22. The prior art used for these rejections is as follows:

- Cellier, F.E. and H. Elmqvist. "Automated Formula Manipulation Supports Object-Oriented Continuous-System Modeling." IEEE Control Systems Magazine. April 1993. Vol.13, Issue 2, pp.28-38. ("**Cellier**").
- Pantelides, C., "The Consistent Initialization of Differential-Algebraic Systems", SIAM Journal of Scientific and Statistical Computing, Vol. 9, 1988, pgs. 213-231. ("**Pantelides**". Cited by Applicant in IDS filed 12/21/2001).

23. Claims 1-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cellier in view of Pantelides.

24. In regards to Claim 1, Cellier teaches the following limitations:

> 1. A method of simulating a system, comprising:
> establishing equations modeling the system using terms having characteristics encapsulated within the terms;
> performing symbolic processing on the established equations for

simplification, wherein the symbolic processing includes utilizing the Panetlides algorithm to reduce the established equations and eliminate an integral ...;

performing system processing on the established equations for efficient simulation,

wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations; and

generating an output that simulates the system.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 1-42.

25. In regards to Claim 2, Cellier teaches the following limitations:

2. The method of claim 1, wherein the stage of defining equations further includes:
defining equations modeling the system using terms selected from one or more basic terms, composite terms, or collection terms.

(See Cellier, especially: pp.35-37)

26. In regards to Claim 3, Cellier teaches the following limitations:

3. The method of claim 1, further including:
extending a library of terms by defining new term classes, wherein term classes define objects having characteristics encapsulated within the objects.

(See Cellier, especially: p.30 "Causality Assignment Problem", first paragraph)

27. In regards to Claim 4, Cellier teaches the following limitations:

4. The method of claim 1, further including:
defining a term group including one or more terms having related functionality;
evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group;
storing the result of the evaluation for each of the one or more terms within the term group; and
recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

(See Cellier, especially: pp.35-37)

28. In regards to Claim 5, Cellier teaches the following limitations:

5. The method of claim 1, wherein utilizing the Pantelides algorithm includes reducing the established equations to a system of equations having a differential-algebraic system of equations index of at most one.

(See Cellier, especially: pp.35-37)

29. In regards to Claim 6, Cellier teaches the following limitations:

6. The method of claim 5, wherein utilizing the Pantelides algorithm further includes:
assigning equations to variables that have non-zero partial

derivatives; and
differentiating the remainder of the equations.

(See Cellier, especially: pp.35-37)

30. In regards to Claim 7, Cellier teaches the following limitations:

7. The method of claim 5, wherein utilizing the Pantelides algorithm further includes:
approximating an algebraic derivative for those equations that cannot be symbolically differentiated.

(See Cellier, especially: pp.35-37)

31. In regards to Claim 8, Cellier teaches the following limitations:

8. The method of claim 5, wherein utilizing the Pantelides algorithm further includes:
symbolically integrating equations that cannot be assigned.

(See Cellier, especially: pp.35-37)

32. In regards to Claim 9, Cellier teaches the following limitations:

9. The method of claim 5, wherein utilizing the Pantelides algorithm further includes:
differentiating equations that add output derivates and integrating equations that add output integrals.

(See Cellier, especially: pp.35-37)

33. In regards to Claim 10, Cellier teaches the following limitations:

10. The method of claim 5, wherein eliminating an integral further includes:
eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship.

(See Cellier, especially: pp.35-37)

34. In regards to Claim 11, Cellier teaches the following limitations:

11. The method of claim 10, wherein eliminating an integral further includes:
utilizing the preferred integration location rank, assigning integrals to equations; and
eliminating the integration of assigned or solved integral variables.

(See Cellier, especially: pp.35-37)

35. In regards to Claim 12, Cellier teaches the following limitations:

12. The method of claim 11, wherein assigning a preferred integration location rank further includes:
assigning a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available
preferred integration location rank;
assigning a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and
assigning all other integration locations a default lowest rank.

(See Cellier, especially: pp.35-37)

36. In regards to Claim 13, Cellier teaches the following limitations:

13. The method of claim 12, wherein the assigned preferred integration location is assigned by a user.

(See Cellier, especially: pp.35-37)

37. In regards to Claim 14, Cellier teaches the following limitations:

14. The method of claim 12, wherein the assigned preferred integration location rank is assigned by a component developer.

(See Cellier, especially: pp.35-37)

38. In regards to Claim 15, Cellier teaches the following limitations:

15. The method of claim 12, wherein utilizing the preferred integration location ranks to assign integrals to equations further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations; establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank, and, if possible, appears linearly in the equation; and repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

(See Cellier, especially: pp.35-37)

39. In regards to Claim 16, Cellier teaches the following limitations:

16. The method of claim 15, further including:
solving each integral equation that is assigned an integral that appears linearly in it;
substituting the solved value into other equations; and
if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

(See Cellier, especially: pp.35-37)

40. In regards to Claim 17, Cellier teaches the following limitations:

17. The method of claim 1, wherein the stage of performing system processing includes:
establishing an initial condition system using the first set of equations and establishing a transient system using the second set of equations.

(See Cellier, especially: pp.35-37)

41. In regards to Claim 18, Cellier teaches the following limitations:

18. The method of claim 17, further including:
defining user defined and component defined initial condition equations for the initial condition system.

(See Cellier, especially: pp.35-37)

42. In regards to Claim 19, Cellier teaches the following limitations:

19. The method of claim 1, wherein performing system processing includes:
performing the system processing on the first set of equations and the second set of equations independently and in parallel.

(See Cellier, especially: pp.35-37)

43. In regards to Claim 20, Cellier teaches the following limitations:

20. The method of claim 1, wherein system processing further includes:
replacing alias variables;
partitioning the equations into blocks;
tearing the blocks;
sorting the blocks; and compressing equation terms.

(See Cellier, especially: pp.35-37)

44. In regards to Claim 21, Cellier teaches the following limitations:

21. The method of claim 20, wherein tearing the equations includes:
identifying block variables in the equations in the block in which the block variables appear linearly with constant coefficients;
solving nonlinear integration equations for their respective integrals;
solving the linear equations;
determining the solvability of the nonlinear equations;
solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; and
scanning the solved variables for identification of variables that are independent and may be removed from the block.

(See Cellier, especially: pp.35-37)

45. In regards to Claim 22, Cellier teaches the following limitations:

22. The method of claim 20, wherein block sorting further includes:
defining and identifying the blocks as static blocks, dynamic blocks, or output blocks;
removing the static blocks from a list of blocks; and
removing the output blocks from the list of blocks.

(See Cellier, especially: pp.35-37)

46. **Claims 23-42 are rejected based on the same reasoning as claims 1-12 and 15-22. Claims 23-42 are machine-readable medium claims that recite limitations equivalent to those recited in method claims 1-12 and 15-22 and taught throughout Cellier and Pantelides.**

47. In regards to Claim 43, Cellier teaches the following limitations:

> 43. A method of simulating systems, comprising:
>
> symbolically processing a set of equations, including:
>
> assigning a portion of the set of equations to variables that have non-zero partial derivatives;
> differentiating the remainder of the set of equations;
> approximating an algebraic derivative for those equations that cannot by symbolically differentiated;
> symbolically integrating equations that cannot be assigned;
> differentiating equations that add output derivates and integrating equations that add output integrals; and
> eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship ...
>
> generating a system for simulation using the symbolically processed set of equations, and
> generating an output that defines a simulated system of interest.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

> wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 43-44.

48. **Claim 44 is rejected based on the same reasoning as claim 43. Claim 44 is a machine-readable medium claim that recites limitations equivalent to those recited in method claim 43 and taught throughout Cellier.**

49. In regards to Claim 45, Cellier teaches the following limitations:

> 45. (Currently amended) A method of eliminating an integral in a Pantelides algorithm performed by a computer-based application that simulates a system, comprising:
>
> ... utilizing the preferred integration location rank, assigning integrals to equations;
>
> eliminating the integration of assigned or solved integral variables: and: generating an output that simulates a system of interest based on the equations.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

assigning a preferred integration location rank to one or more integrals;

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 45-48.

50. In regards to Claim 46, Cellier teaches the following limitations:

> 46. (Original) The method of claim 45, wherein assigning a preferred integration location rank, further includes:
> assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;
> assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and
> assigning all other integration locations a default lowest rank.

(See Cellier, especially: pp.35-37)

51. In regards to Claim 47, Cellier teaches the following limitations:

47. (Original) The method of claim 46, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes: identifying integral variables that appear linearly and nonlinearly in the integral equations; establishing a current preferred integration location rank at a default setting; assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and. repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

(See Cellier, especially: pp.35-37)

52. In regards to Claim 48, Cellier teaches the following limitations:

48. (Original) The method of claim 47, further including:
solving each integral equation that is assigned an integral that appears linearly in it;
substituting the solved value into other equations; and
if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

(See Cellier, especially: pp.35-37)

53. In regards to Claim 49, Cellier teaches the following limitations:

49. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of eliminating an integral in a Pantelides algorithm used by an application that simulates a system, the method comprising:
... utilizing the preferred integration location rank, assigning integrals to equations;
eliminating the integration of assigned or solved integral variables, and generating an output that defines a simulated system.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

assigning a preferred integration location rank to one or more integrals;

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 49-52.

54. In regards to Claim 50, Cellier teaches the following limitations:

> 50. (Original) The machine-readable storage medium of claim 49, wherein assigning a preferred integration location rank, further includes:
>
> assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;
> assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and
> assigning all other integration locations a default lowest rank.

(See Cellier, especially: pp.35-37)

55. In regards to Claim 51, Cellier teaches the following limitations:

> 51. (Original) The machine-readable storage medium of claim 50, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

(See Cellier, especially: pp.35-37)

56. In regards to Claim 52, Cellier teaches the following limitations:

52. (Original) The machine-readable storage medium of claim 51, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

(See Cellier, especially: pp.35-37)

57. In regards to Claim 53, Cellier teaches the following limitations:

53. (Currently amended) A method of simulating systems; comprising:
performing a tearing process on a set of equations, including:

identifying block variables in the equations in a block in which the block variables appear linearly with constant coefficients;

determining the solvability of the nonlinear equations;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations;-and

scanning for solved for variables for identification of variables that are independent and may be removed from the block;

generating a system for simulation using the processed equations; and

generating an output that simulates a system of interest based on the processed equations.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 53-54.

58. **Claim 54 is rejected based on the same reasoning as claim 53. Claim 54 is a machine-readable medium claim that recites limitations equivalent to those recited in method claim 53 and taught throughout Cellier and Pantelides.**

59. In regards to Claim 55, Cellier teaches the following limitations:

> 55. A method of simulating a system, comprising:
> establishing equations modeling the system using terms having characteristics encapsulated within the terms;
> ...
> performing system processing on the established equations for efficient simulation, and

wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations.

See Cellier, especially: pp.35, left column, to p.37. Cellier, however, does not expressly teach the following limitation:

performing symbolic processing on the established equations for reducing the number of terms in the equations; and

Pantelides, on the other hand, expressly teaches that limitation.

Cellier and Pantelides are analogous art because they are from the same field of endeavor, solving differential equations.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the teachings of Cellier with those of Pantelides by implementing the elements of the Pantelides algorithm.

The suggestion/motivation for combining the references is expressly stated in p.35 of the Collier reference, which expressly teaches that "This algorithm has been implemented in Dymola."

Therefore, it would have been obvious to a person of ordinary skill in the art to modify Collier with Pantelides to obtain the invention as specified in Claims 55-58.

60. In regards to Claim 56, Cellier teaches the following limitations:

56. The method of claim 55, further including:
defining a term group including one or more terns having related functionality;
evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group; and
storing the result of the evaluation fro each of the one or more

terms within the term group.

(See Cellier, especially: pp.35-37)

61. In regards to Claim 57, Cellier teaches the following limitations:

> 57. The method of claim 56, further including:
> recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

(See Cellier, especially: pp.35-37)

62. **Claim 58 is rejected based on the same reasoning as claim 55. Claim 58 is a method claim that recites limitations equivalent to those recited in method claim 55 and taught throughout Cellier.**

63. In regards to Claim 59, Cellier teaches the following limitations:

> 59.(New) A method of simulating a system, comprising:
> establishing equations modeling the system;
> performing symbolic processing on the established equations for simplification;
> establishing a first set of equations including equations modeling the system and initial condition constraints;
> establishing a second set of equations including equations modeling the system and numeric integration equations that constrain integrated variables; and
> processing the first and second sets of equations independently and in parallel, to generate initial condition and transient solutions.

Claim 59 is rejected on the same grounds as claim 1.

64. In regards to Claim 60, Cellier teaches the following limitations:

> 60. (New) The method of claim 59, wherein establishing equations modeling the system comprises establishing component equations, connectivity equations, and boundary condition equations; and wherein each of the first and second set of equations includes component, connectivity, and boundary condition equations.

Claim 60 is rejected on the same grounds as claim 2.

Response to Arguments

Re: Claim Rejections - 35 USC § 101

65. Applicant's arguments regarding the previous 101 rejections are addressed in the 101 rejections, which have been rewritten to address the issue in more detail.

Re: Claim Rejections - 35 USC § 102

66. The Examiner has withdrawn all rejections based on the Feehery reference.

Re: Claim Rejections - 35 USC § 103

67. After the filing of the RCE, Examiner performed an updated search and found relevant prior art. Newly amended claims 1-60 have been rejected under the newly found art.

Conclusion

68. The following prior art, made of record and not relied upon, is considered pertinent to applicant's disclosure.

69. Pye, John. "Pantelides Algorithm in PHP." Last modified May 16, 2005. http://pye.dyndns.org/pantelides/.

70. Cellier, Francois. "The Structural Singularity Removal Algorithm by Pantelides." Sept. 15, 2003. http://www.ece.arizona.edu/~cellier/ece449_ppt.pdf.

Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ayal I. Sharon whose telephone number is (571) 272-3714. The examiner can normally be reached on Monday through Thursday, and the first Friday of a bi-week, 8:30 am – 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached at (571) 272-3753.

Any response to this office action should be faxed to (571) 273-8300, or mailed to:

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Tech Center 2100 Receptionist, whose telephone number is (571) 272-2100.

Ayal I. Sharon
Art Unit 2123
January 31, 2007

PAUL RODRIGUEZ
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

1/31/07